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RUBBER BASED AGROFORESTRY SYSTEMS: OPTIONS FOR SMALLHOLDERS

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Summary

Representing more than 80% of the total rubber areas, smallholder rubber plantations and its system, in Indonesia, are very unique in the world. The system, often referred to as "jungle rubber" is multi-strata in nature, and rubber is not the only crop harvested from the system but many other timber trees (usually through natural regeneration), fruit trees and annual crops are inter-cropped. These multi-strata systems have multiple functions - income source for many smallholder farmers, biodiversity and water conservation and carbon sequestration. Large efforts have been done by the Indonesian Government to improve the rubber productivity of traditional cultivation system by converting to more intensive monoculture systems. However, the rate of adoption of this technology is very slow considering the area of rubber in Indonesia. Taking into account the positive aspects of traditional rubber agroforestry ICRAF, CIRAD and IRRI worked jointly to develop and field test various improved Rubber Agroforestry System (RAS) that can provide smallholder farmers more appropriate alternatives to monoculture rubber. In all trials, recommended germplasm of rubber clones is used instead of conventional rubber seedlings. A network of trial-cum-demonstration RAS plots has been established in different provinces in Indonesia since mid nineties. The results from the wide network provided various adaptations; especially in terms of management intensity (weeding, fertilizer application) made by farmers and indicated feasible technology that farmers can benefit from. Rubber clones PB 260, RRIC 100 and BPM1 were compared with local seedlings in terms of plant growth. With lessons from earlier work, new demonstration plots of improved RAS have been established Aceh Barat District in NAD.

Key words : Rubber Agroforestry system, Indonesia , Aceh, On farm experimentation.

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INTRODUCTION

Indonesia has the biggest area (3.5 million ha) under planted rubber *Hevea brasiliensis*), nearly 80 percent of this is managed by smallholder farmers cultivating less than 5 ha plots. The productivity of smallholder rubber in this country is very low, between 600 to 800 kg/ha/year, or half of that of Thailand. This is attributed to (i) farmers using wildlings (unselected seedling) as planting material; (ii) slow and heterogeneous growth of rubber trees; (iii) very low level of management (weeding, fertilizers); and (iv) traditional system of multi-strata rubber, referred to as “jungle rubber” in which natural regrowth of other plants are tolerated or maintained with or without purpose.

Traditionally rubber agroforests in Indonesia are established after a slash and burn of secondary forest or old jungle rubber, followed by planting of annual food crops in between rubber rows for 2-3 years. The plots are let alone, allowing other natural vegetation to grow. When the rubber trees reach tapping size, farmers return, do some clearing and start tapping rubber trees. In a rural context the system is an important source of income for farmers; it requires little capital, cash and labour. Management is usually limited to occasional cleaning and weeding; fertilizers or chemicals are almost never applied. Latex productivity is low; but the system produces a range of food, fruits, vegetables, timber, rattan, medicinal herbs. The intensive monoculture system is often costly and does not provide farmers with other necessities of smallholder farmers (Supriadi and Nancy, 2001).

Rubber clones have high productivity, 2-3 times of that unselected seedlings, have homogenous growth, and respond to production inputs (fertilizers, weeding). But the clonal planting materials are costly for farmers (between 0.25–0.30 USD/polybag) and often reliable source of assured quality is not available locally. Additionally, the recommended clones are based on their performance in intensive monoculture system under zero competition with other plant species. The clone performance under traditional practice was virtually unknown but the potential for incorporating clonal material for smallholder farmer system is potential.

Since 1994 the World Agroforestry Centre (ICRAF) in association with CIRAD-France and Indonesian Rubber Research Institute established a network of on-farm trials in West Kalimantan, Jambi and West Sumatra, and recently in South Sumatra. The primary aim was to study different options of improved Rubber Agroforestry System RAS under farmer management, and to demonstrate the feasibility of these options to participant farmers, their neighbours, government agencies, NGOs, development professionals and researchers associated with natural rubber (Penot, 2001).

Three types of distinct RAS technology were tried. RAS-1 is similar to traditional jungle rubber system; only unselected rubber seedlings are replaced by recommended clones. In RAS-2 other perennial timber and fruit trees are planted with rubber. RAS-3 is designed for establishing rubber in *Imperata* grassland by using cover crops (*Mucuna*, *Flemingia*, *Crotalaria*) and fast growing and multipurpose tree species that can be harvested before rubber trees reach tapping size (Penot, 2000, 2006).

MATERIALS AND METHODS

The trial-cum-demonstration plots were established in three phases: fist in 1995-1996 with 10 types of trial; second in 2001 with three types of trial; and finally in 2004 consist of 7 types of trial. Each trial consists of 3 to 5 plots or replications, with only one or two simple treatments. In total there are 150 plots that cover 100 hectares. The treatments included weeding frequency, fertilizer application, rice variety x fertilizer, type of associated trees, and types of cover crops. These plots were routinely monitored especially for farmer activities on weeding and fertilizer application, including diversion from agreed protocols. Regular measurements were taken for growth of rubber trees. The rubber growth data was used to develop a typology of farmer management. Numerous analyses, both quantitative and qualitative, on many aspects of RAS are being carried out.

RESULTS AND DISCUSSION

Clone comparison

Only the yield data is for only three initial years of tapping in the trial plots, the comparative advantage of recommended clones over traditionally used unselected clones is already evident (Table 1). In the third year of tapping trees from seedlings yielded only 518 kg dry rubber/ha while the clones produced more than three times this. Among the clones, PB260 was the top performer.

Table 1. Production data from on-farm field trial (3rd year of tapping)

Description	PB 260	RRIC 100	BPM 1	RRIM 600	Seedling
Yield gm/tree/tapping	32	29	28	27	15
Yield kg/tree/year	4.2	3.9	3.8	3.6	1.5
Nb. tappings/year	135	134	134	136	120
Nb. trees/ha	422	371	371	375	339
Yield kg/ha/year	1794	1508	1430	1442	518

Rubber growth and farmer typology

While RAS technology started off with 3 distinct types with numerous sub-types, the results after a decade of observation and monitoring was very mixed and messy. Farmers in general did not follow the agreed protocols rendering it impossible to analyse the results on the basis of types and sub-types of RAS. Some farmers managed their plots well and rubber trees grew well and reached tapping size relatively quickly. Some farmers essentially left the plots unattended (as in jungle rubber) without regular cleaning and fertilizer application. This range of farmer activities provided an important insight into the reality of smallholder rubber cultivation in Indonesia.

As the growth of rubber trees reflects the combined effect of thee genetic potential of rubber and farmer input (weeding, fertilizer, pest control). The data indicated a highly dominant effect of farmer management, masking the influence of different clones or different RAS types and sub-types. We took an exercise to group plots based on rubber tree growth; nine different patterns emerged (Figure 1). In some plots, rubber trees grew faster than in normal intensive systems. The rubber trees reached tapping size (45 cm trunk girth at 1 m above ground) in about 4.5 years. The farmers had managed their plots in a very intensive manner with high input leading to high output performance. On the other hand, there are farmers who managed their plots but provided less input. In some cases, farmers periodically left the plots unattended due to various reasons such as illness, death in family, travelling, working elsewhere. In these plots, the rubber trees grew much more slowly, reaching tapping size in more than 8 years. Some plots were severely damaged by pests, while a few were essentially abandoned by their owner at an early stage. Data from these plots were not collected, hence not included in the analysis.

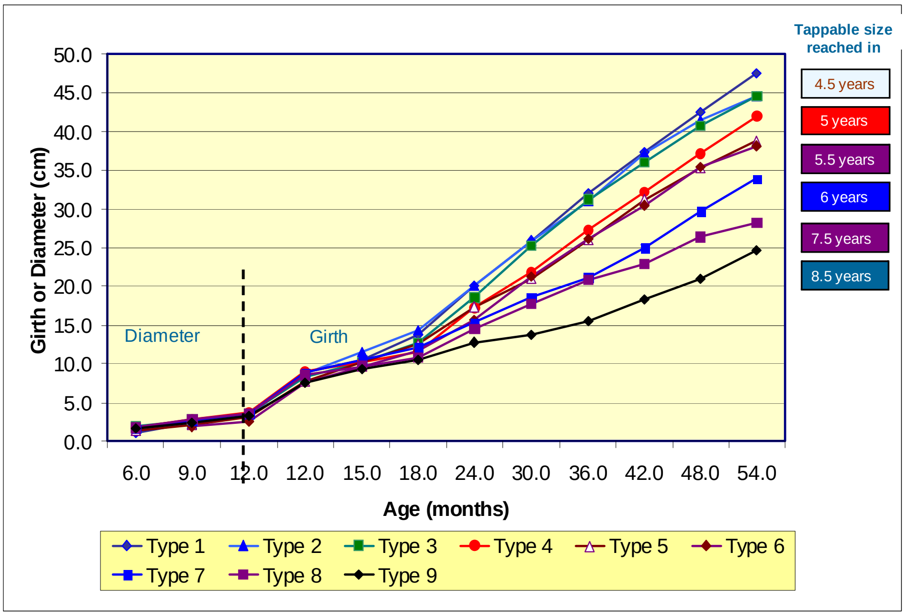

Figure 1. Rubber tree growth in trial plots and identification of 9 different farmer “types”, based on number of years before tapping. Five years is used as common standard.

Tapping frequency and latex yield

There is general perception among farmers that more frequent tapping of rubber trees gives more latex. When the latex yield data for different plots are plotted against frequency of tapping, this common perception has some validity, but to a certain limit. A number of facts emerge from this analysis. First, the increase in yield decreases with increasing tapping frequency (decreasing rate of return) as is obvious in Figure 2. The yield probably peaks at around 250 days of tapping a year. Few farmers tap at this frequency; most tapped fewer than 150 days a year. This is contrary to the commonly held belief that farmers tap unnecessarily too frequently (6 days a week). Second, some farmers achieved a very high yield (above 2000 kg dry rubber per ha per year) even at 120 to 150 days of tapping. This indicated the validity of recommended tapping frequency d2 or d3 (3 or 2 times a week). Third, in numerous cases, even under less than 100 tapping days, latex yield reached above 1500 kg dry rubber per ha per year. Those skilled farmers tapped their rubber deeply, without wounding the wood. This is a significant finding related to us of tapping labour both for smallholders and large scale intensive plantations.

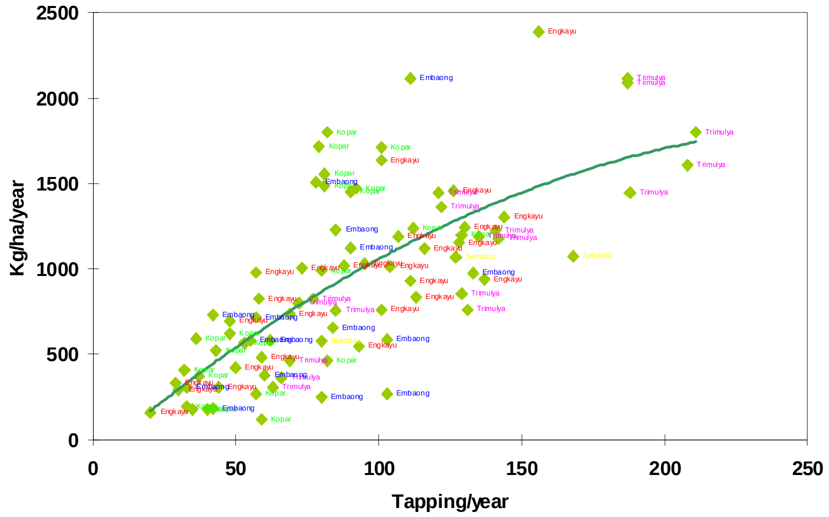

Figure 2. Latex yield plotted against tapping frequency.

CONCLUSIONS

On-farm trials are inherently more complicated to manage than on-station trials, largely because of the uncontrollable variable of farmer behavior and other external factors. However, they provide key information about the reality when farmers adopt or adapt any new technology. The long term on-farm rubber trial-cum-demonstration network has provided invaluable information about smallholder rubber system in Indonesia. It is important to have flexibility in any new technology that enables farmers to adapt the technology to their needs and available resources (weed management, tapping, fertilizer application, intercrops).

The importance of improved germplasm of clonal rubber plants is evident from the data on latex productivity. Even at medium level management, it is possible for farmers to receive about three times more latex than from unselected seedlings of rubber. In on-farm trial, rubber trees reached tappable size in 4.5 to 8.5 years after planting, and the rate of tree growth is understandably determined by management intensity. The data on latex yield from RAS demonstration plots are comparable to monoculture plantations. It appears 70% or higher productivity of intensive monoculture rubber is possible through well managed smallholder RAS. Farmers around demonstration plots are beginning to adopt RAS approach as an alternative to both intensive monoculture and extensive jungle rubber. The integrated RAS approach of combining new technology (clonal rubber) with traditional practice of rubber agroforestry has proven successful. Needless to say that mixed RAS is also more beneficial to the environment and biodiversity compared to monoculture rubber.

Based on the lesson and findings from previous work, demonstration plots of RAS have been recently established in Aceh. Some modifications to tree spacing to incorporate high value annual and perennial crops were made in the new demonstration plots. Close supervision and monitoring, technical support to farmers for few more years will be necessary before results can be seen. The increasing interest of farmers on rubber production, the high value of rubber and other commodities and environmental awareness of the people will make the improved RAS more pertinent in future.

Bibiography

Penot E (2000). *Les agroforêts à hévéas améliorées en Indonésie ; mythe ou réalité?* PRD 2000, Novembre, n° 4, CIRAD, Monpellier.

Penot, E. (2001). Stratégies paysannes et évolution des savoirs : l'hévéaculture agro-forestière indonésienne. Thèse de doctorat. Faculté des Sciences Economiques. Montpellier, Université Montpellier I.: 360p.

Penot E (2006). From Shifting Cultivation to Sustainable Jungle Rubber: A History of Innovations in Indonesia. Chapter 48 of the book Voices from the Forest Integrating Indigenous Knowledge into Sustainable Upland Farming. Malcolm Cairns, editor. 2006. Browse Book. 880 p.

Supriadi and Nancy, 2001